Fecal and cecal pH in horses fed hay only og hay and pelleted barley

Jensen, Rasmus Bovbjerg; Næsset, J.A.; Austbø, D.; Tauson, Anne-Helene

Published in:
Proceedings of the 4th Nordic Feed Science Conference

Publication date:
2013

Document version
Early version, also known as pre-print

SLU

Proceedings of the 4th Nordic Feed Science Conference, Uppsala, Sweden

Nordic Feed Science Conference

12 - 13 June 2013

www.slu.se/nordicfeedscienceconference

Institutionen för husdjurens utfodring och vård

Swedish University of Agricultural Sciences Department of Animal Nutrition and Management

Rapport 287
Report

Uppsala 2013

ISSN 0347-9838
ISRN SLU-HUV-R-287-SE

Published by:
Organising committee of the 4th Nordic Feed Science Conference
Department of Animal Nutrition and Management
Swedish University of Agricultural Sciences (SLU)
SE- 753 23 Uppsala, Sweden

Organising Committee:
Peter Udén
Rolf Spörndly
Bengt-Ove Rustas
Torsten Eriksson
Cecilia E. Müller
Marie Liljeholm

Edited by:
P. Udén
T. Eriksson
B-O. Rustas
C.E. Müller
R. Spörndly
T. Pauly
M. Emanuelson

Printed by:
SLU Repro
SE-75007 Uppsala, Sweden

Distributed by:
Department of Animal Nutrition and Management,
Kungsängen Research Centre
SE-75323 Uppsala, Sweden

www.slu.se/husdjur-utfodring-vard

Fecal and cecal pH in horses fed hay only or hay and pelleted barley

R.B. Jensen[1], J.A. Næsset[2], D. Austbø[2] and A.-H. Tauson[1,2]
[1]*Department of Veterinary Clinical and Animal Sciences, University of Copenhagen, Grønnegårdsvej 3, DK-1870 Frederiksberg C, Denmark.* [2]*Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, P.O. Box 5003, N-1432 Ås, Norway*
Correspondence: R.B. Jensen, ralle@sund.ku.dk

Introduction

Diet effects on the hindgut environment are sometimes evaluated based on a single fecal sample (Berg et al. 2005; Zeyner et al. 2004) as the accessibility of cannulated horses is limited. Whether a fecal sample really mimics the hindgut environment is though questionable. Four cecum cannulated horses were used to study diet effects on pH changes simultaneously in the cecum and in feces over 24 hours, when two different diets were fed in a cross over experiment.

Materials and Methods

The experimental periods consisted of twelve days of adaption to a diet followed by one day of measurements. The horses were housed individually in stalls with wood shavings as bedding material and allowed access to a dirt paddock for approximately six hours a day during the adaption period. The two diets fed in the experiment were a hay only diet (diet 1) or a hay supplemented with concentrate diet (diet 2). The horses were fed 2.7 kg of hay 3 times a day (06:00, 14:00 and 22:00 h) when fed diet 1, and 2.0 kg of hay 3 times a day (06:15, 14:00 and 22:00 h) supplemented with 2.1 kg of pelleted barley (~2 g starch per kg body weight) fed once a day (06:00 h) when fed diet 2. The feeding is illustrated in Figure 1, where 06:00 h = time 0.

The horses were fitted with a permanent cannula at the base of the cecum close to the ileocecal junction, from where samples of cecal fluid could be obtained. Samples of cecal fluid and feces were collected just before the 06:00 h meal and sampling continued for 24 hours. Every hour a sample of approximately 100 ml cecal fluid was taken and pH was measured immediately, and every second hour a fecal grab sample was taken (simultaneously with the cecal sample) and pH was measured immediately after mixing of 15 g of feces with 15 g ionized water.

The data was analyzed as repeated measurements using the MIXED procedure SAS® (Version 9.3, SAS Institute Inc. Cary, North Carolina, USA) where diet, time and the interaction diet x time were included as fixed effects, and horse and period within horse were included as random effects. Mean effects were considered statistically different if $P<0.05$.

Results and Discussion

The pH changes in the cecum and in feces measured over 24 hours are shown in Figure 1. The mean pH of the two diets at each time point and the standard error of the mean (SEM) are presented. The decrease in cecal pH on diet 2 was probably caused by easily fermentable starch reaching the cecum, and as expected there was an effect of the interaction diet x time ($P<0.001$) on pH changes in the cecum. Cecum pH was lower 2 to 9 hours after feeding on diet 2 compared to diet 1. The pH was much more stable when diet 1 was fed, and the three daily meals of hay only caused small fluctuations in cecum pH. The SEM was also much smaller when hay was fed compared to the meal of barley, as can be seen in Figure 1, which

shows that the individual variation was larger when the horses were fed diet 2 compared to diet 1. Chewing intensitiy might have affected the small intestinal digestibility of the starch (Meyer *et al.* 1995) and differences in hay intake time might have influenced the passage rate through the stomach and small intestine (Kienzle 1994).

Fecal pH was lower than cecal pH (Figure 1), and there was no effect of diet (P=0.40) or the interaction diet x time (P=0.50) on fecal pH, however, there was an effect of time (P=0.02). A similar effect of time of sampling was also reported by Jensen *et al.* (2013) when two concentrate meals were compared and pH in feces was evaluated. This illustrates the importance of taking fecal samples at the same time in experiments where only one sample is taken, to obtain comparable results.The mean retention time of feedstuffs is often 24 hours or more but varies depending on several factos (e.g. feedstuffs and feeding level) (Van Weyenberg *et al.* 2006). The effect of the barley meal fed the day before on fecal pH was expected to be seen after the morning meal with a time delay of ~24 hours or more. However, it was not possible to see a clear decrease in fecal pH at any time that could be explained by the single barley meal in diet 2.

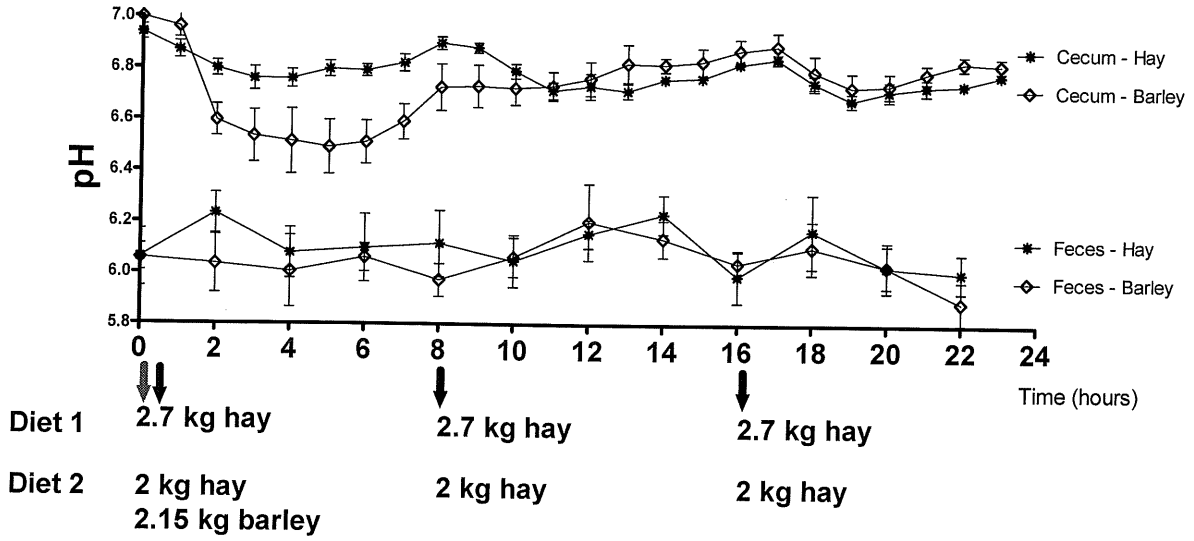

Figure 1 The effect of hay or a hay supplemented with pelleted barley diet on cecal and fecal pH measured over 24 hours (mean ± SEM). The arrows illustrate feeding times and amounts.

The diets might not have been extreme enough to cause an effect of diet on pH in feces. If the level of barley had been higher it could be expected that fecal pH had been lower on a mixed diet compared to a hay only diet.

Conclusions

The effect of diet on pH changes in the cecum were clearly documented, when a diet containing pelleted barley was compared to hay. However, these effects were not found in fecal samples in which only sampling time affected the results when studying diet effects on fecal pH.

References

Berg, E.L., Fu, C.J., Porter, J.H., Kerley, M.S., 2005. Fructooligosaccharide supplementation in the yearling horse: Effects on fecal pH, microbial content, and volatile fatty acid concentrations. J. Anim. Sci., 83, 1549–1553.

Jensen, R.B., Austbø, D., Tauson, A.-H., 2013. Fecal and cecal pH in horses fed pelleted barley. Proc. of the 6th European Equine Health and Nutrition congress, Ghent, Belgium, 1st-2nd March 2013, p. 166.

Kienzle, E., 1994. Small intestinal digestion of starch in the horse. Revue. Méd. Vét., 145, 199-204.

Meyer, H., Radicke, S., Kienzle, E., Wilke, S., Kleffken, D., Illenseer, M., 1995. Investigation on preileal digestion of starch from grain, potato and manioc in horses. J. Vet. Med. (Series A), 42, 371-81.

Van Weyenberg, S., Sales, J., Janssens, G.P.J., 2006. Passage rate of digesta through the equine gastrointestinal tract: A review. Livestock Sci. 99, 3-12.

Zeyner, A., Geißler, C., Dittrich, A., 2004. Effects of hay intake and feeding sequence on variables in faeces and faecal water (dry matter, pH value, organic acids, ammonia, buffering capacity) of horses. J. Anim. Physiol. Anim. Nutr., 88, 7–19.